



California Energy Commission - 2011 Integrated Energy Policy Report and Energy Storage Program Overview

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California Public Utilities Commission R10-12-007/AB 2514 Electric
Energy Storage Workshop

June 28, 2011

CPUC Headquarters – Golden Gate Room, San Francisco, CA

Purpose



- 2011 Integrated Energy Policy Report Committee Workshops
- Public Interest Energy Research Program Overview
- Energy Storage Program Overview
- Energy Storage Research Projects and Activities
 - American Recovery and Reinvestment Act (ARRA) Projects
 - Lawrence Livermore National Laboratory - Modeling Entire California Grid and Assessing Energy Storage/Auto-DR/New Generation Needs
 - CIEE – Strategic Analysis of Energy Storage

Public Interest Energy Research



- Established through AB 1890 in 1996 and began in 1998
- ~\$62.5 Million / Year (Electricity); ~\$24 Million / Year (Natural Gas) since 2005-2006
- Mission - To support public interest energy research and development that helps improve the quality of life in California by bringing environmentally safe, reliable, and affordable energy services and products to the marketplace.
- Six (6) PIER Program Research Areas; Efficiency {Buildings and Industry/Agriculture/Water}, Renewables, Environment, Transportation, Energy Systems (Transmission and Distribution {Smart Grid}, Cyber Security, and **Energy Storage**)

PIER Involvement in Energy Storage Technologies



- PIER has a long history of interest in advancing energy storage technologies:
 - Funding field demonstrations and studies
 - Encouraging partnering and information exchange
- Energy Storage Research Projects and Activities
 - American Recovery and Reinvestment Act (ARRA) Projects
 - Lawrence Livermore National Laboratory - Modeling Entire California Grid and Assessing Energy Storage/Auto-DR/New Generation Needs
 - CIEE – Strategic Analysis of Energy Storage

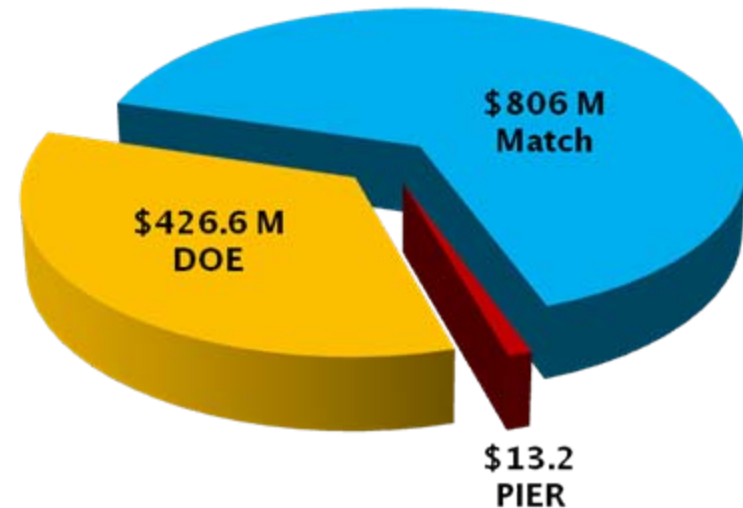
ARRA Smart Grid Projects



18 California Based Projects Totaling ~\$1.25 Billion

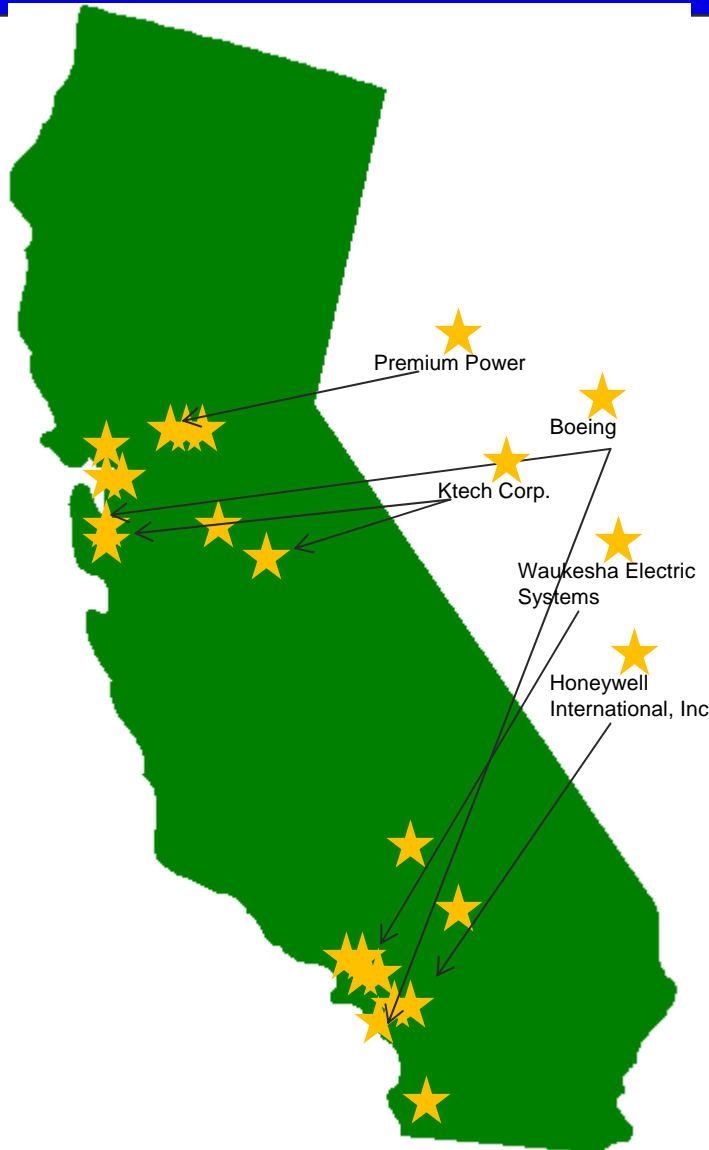
Why PIER Provided Cost-Share For ARRA

- Without PIER funding DOE would not award (*DOE recognizes CA's leadership in Smart Grid*)
- Early call To Identify How Smart Grid Is Developing
- Ensure Consistency Among California Projects
- One Smart Grid for California (*Energy Commission Is The Common Participant For All Projects*)



- | | | | | |
|-----------------|-----------------|------------------|---------------------|-------------|
| ▪ Smart Meters | ▪ Communication | ▪ Storage | ▪ Consumer Behavior | ▪ Standards |
| ▪ Grid Security | ▪ Phasors | ▪ PHEV | ▪ Demand Response | ▪ HAN |

ARRA Smart Grid in California



Total Project Value to CA - \$1.3 Billion

- City of Glendale Water & Power
- Modesto Irrigation District
- Burbank Water & Power
- City of Anaheim
- Electric Power Group (WECC sub-contractor)
- Pacific Gas & Electric (WECC sub-contractor – Not with CEC)
- Sacramento Municipal Utility District
- San Diego Gas & Electric
- Los Angeles Department of Water & Power
- Southern California Edison with Boeing - Headquarters in MO, work being done in Sunnyvale and Huntington Beach, CA
- Southern California Edison with Waukesha Electric Systems - Headquarters in WI, work being done with SCE in Irvine, CA) (Fault Current Limiting Transformer)
- Primus Power (Metal Electrodes for Zn/Cl Flow Battery)
- SEEO Inc. (Li-Polymer)
- Southern California Edison (Tehachapi Wind Energy Storage (CAES))
- Pacific Gas & Electric (CAES)
- Amber Kinetics (Flywheel)
- EnerVault with Ktech Corp. - Headquarters in NM, work being done in Sunnyvale, CA (Fe/Cr Flow Battery)
- Sacramento Municipal Utility District - sub-contractor to Premium Power, Headquarters in MA (Zn/Br Battery)
- California State University, Sacramento (Smart Grid Study)

CIEE Energy Storage Research Project



- Goal - Develop a framework for 2020 Energy Storage Vision for California
- California Institute for Energy and Environment (CIEE) - Prime Contractor and supported by UC (Berkeley, Los Angeles, and San Diego)
- Project Advisory Committee includes – IOUs, CAISO, POU, CESA/ESA, National Labs, EPRI, Energy Storage Industry/Providers, CPUC, etc.
- Duration ~6 Months (Began on January 24, 2011)
- Help determine the role of energy storage in California
 - Look at various energy storage technologies and applications
 - Support CPUC with AB 2514 OIR Proceedings (March 9 & June 28, 2011)
 - Input to 2011 IEPR Committee Workshop on Energy Storage (April 28, 2011 following the November 16, 2010 Energy Storage Workshop)

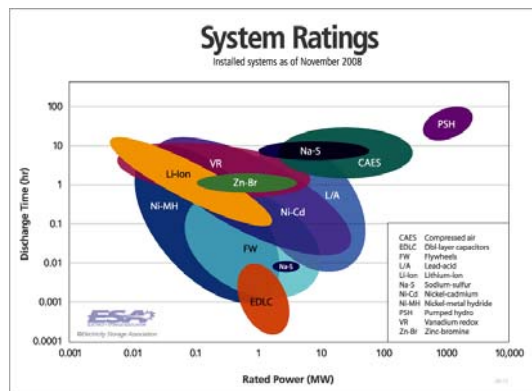


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Strategic Analysis of Energy Storage Technologies

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Electric Energy Storage Workshop
California Public Utilities Commission
June 28, 2011
San Francisco, California

Energy Storage Vision Project

- Part 1: (A) Technical status review of various technologies and research and development needs. (B) Regulatory and policy review.
- Part 2: Strategic vision of energy storage scenarios over next ten years.
- Highlights value of energy storage to meet future state energy goals



Energy Storage Vision Project , Part 2

Approach – Envisioning a Path to 2020

Elements of a Vision Framework:

- California's grid needs and ES applications
- Policy, regulatory, and market-based drivers
 - Baseline
 - Accelerated
- Assessment of costs, benefits and likely outcomes of storage deployment scenarios.

Energy Storage Vision Project , Part 2

Approach – Envisioning a Path to 2020

- 3 exemplary applications
 - Frequency Regulation
 - Renewables Grid Integration
 - Community Energy Storage/ DESS
- CPUC targets and/or other policy & regulatory mechanisms
- Ongoing research needs, milestones, and next steps

Energy Storage Vision Project, Part 2

Preliminary Findings – Envisioning a Path to 2020

Application 1: Frequency Regulation

- Technologies and R&D Needs
- Baseline Scenario:
 - FERC, CAISO → Lowering barriers to participation in wholesale market
- Accelerated Scenario:
 - CAISO → Compensation rewards speed and accuracy; Pay-for-performance/ “mileage”
 - CPUC → Long-term contract capability; RA value for regulation services; AB 2514 Targets; Valuation methodology includes environmental benefits

Energy Storage Vision Project, Part 2

Preliminary Findings – Envisioning a Path to 2020

Application 1: Frequency Regulation

■ Benefits

- Reduce (1) regulation capacity needs, (2) reliance on conventional resources and stress on generator equipment, and (3) GHG emissions

■ Cost Factors

- High value market but limited market size
- Value likely to increase
- Possible to “stack” values, but not simultaneously

■ Milestones: FERC & CAISO outcomes

Energy Storage Vision Project, Part 2

Preliminary Findings – Envisioning a Path to 2020

Application 2: Renewables Grid Integration

- Technologies and R&D Needs
- Baseline Scenario:
 - Factors – RA & LTPP; On-off peak price spread; T&D deferral values; CAISO renewable integration market & product review
- Accelerated Scenario:
 - CPUC → RA value or “adder”; LTPP includes cost of transmission & RA capacity gaps; Impose ramping limits on variable renewables; AB 2514 Targets;
 - CAISO → PIRP value for forecast & delivery accuracy

Energy Storage Vision Project, Part 2

Preliminary Findings – Envisioning a Path to 2020

Application 2: Renewables Grid Integration

■ Benefits

- Reduce (1) Need for increased ramping, (2) curtailment, (3) integration costs, (4) T&D capacity expansion; Improve capacity factor

■ Cost Factors

- Less \$ value, but potentially large market size
- Value streams are defined but not all monetized
- Possible to “stack” value and aggregate benefits

■ Milestones: CAISO 33% study; Renewable Integration Market & Product Review

Energy Storage Vision Project, Part 2

Preliminary Findings – Envisioning a Path to 2020

Application 3: Community Energy Storage/ DESS

- Technologies and R&D Needs
- Baseline Scenario:
 - Depends on... Increasing variable distributed generation & associated integration costs; CPUC interconnection rules; IOU smart grid plans
- Accelerated Scenario:
 - Consider DESS for revised interconnection standards; Valuation of distribution deferral, avoided DG integration costs; AB 2514 targets

Energy Storage Vision Project, Part 2

Preliminary Findings – Envisioning a Path to 2020

Application 3: Community Energy Storage/ DESS

■ Benefits

- Utility-side: Distribution deferral; Lower variable DG integration costs (smoothing; voltage support avoid energy “back-flow”); Local reserve capacity;
- Customer-side: Improved power quality, reliability, and value; Distribution-level outage mitigation;

■ Cost Factors

- Potentially high value, may be highly localized
- Possible to “stack” value and aggregate benefits
- Increased value close to high-penetration PV DG

Energy Storage Vision Project, Part 2

Preliminary Findings – Envisioning 2020

What does this mean for targets?

- Vision Framework presents considerations for AB 2514 process
 - CAISO – grid needs under 33%
 - CEC-funded study of grid needs for DR and EES
 - Market design changes under FERC, CAISO
 - Purpose(s) of any targets must be well-defined
 - Targets may be structured to maximize benefits by being application-specific
- CPUC should begin valuation work early and identify cost-recovery methods simultaneously

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Questions & Comments?

Energy Storage Vision Project, Part 1 Approach – Technology Status

- Survey existing technical and cost data
- Identify ongoing R&D needs so that
 - “procurement targets and policies that are established are technologically viable & cost effective.”
- Analyze feasibility of accelerated deployment

Energy Storage Vision Project, Part 1

Preliminary Findings – Technology Status

■ Technology Survey

- Large, grid-scale energy storage technologies (e.g., pumped hydro and CAES) are being commercialized
 - Challenges: include siting, permitting, and associated environmental impact processes
- Modular technologies demonstrations (e.g., batteries, flywheels) in grid applications are being initiated
 - Challenges/ questions are primarily related to cost, scalability, lifetime/durability, limited experience in grid applications
 - Modularity of the technologies offers promise for cost reduction through volume production

Energy Storage Vision Project, Part 1

Preliminary Findings – Technology Status

- Ongoing R&D needs
 - ❑ Bulk storage demos for renewables integration
 - ❑ Field demos of modular technologies in various grid applications
 - ❑ Evaluation of aggregated storage, especially in a Smart Grid scenario
 - ❑ Quantification of costs and benefits in grid applications
 - ❑ Modeling impact of 33% renewables on CA electricity grid to determine needs for storage

Energy Storage Vision Project, Part 1

Approach – Policy & Regulatory Background

- Survey state and federal energy law & policy
- Identify key regulatory proceedings and policy developments
- Highlight activities in other jurisdictions
- Assess barriers to accelerated deployment and potential solutions

Energy Storage Vision Project, Part 1

Prelim. Findings – Policy & Regulatory Background

- *Policy push* – policies in place
- *Regulatory response* – key proceedings
 - FERC
 - CPUC
 - CAISO
 - ARB
- *Market pull* – utility and industry response
- Barriers to accelerated deployment
 - Technology Cost
 - Competing policies?
 - Valuation and monetization
 - Awareness and collaboration